1851. In 1889 the Commissioners announced their intention of appropriating from their accumulated funds an annual sum of not less than 5000*l.* a year for the foundation of scholarships to enable the most promising students in selected colleges to continue their studies beyond the ordinary period of three years, provided that they show high promise for advancing science and its applications. The scholarships are awarded, not by examination, but upon the nomination of the institutions to which they were allotted, and their value is 150*l.* a year for two years, with possible extension to three years. The principle of selection was decidedly in advance of any scheme existing at the time, and the value of the scholarships is sufficient to encourage students of high capacity to devote time to research.

These scholarships are given for research only, and they are not allowed to be held at the institution where the scholar has graduated. It is acknowledged that nothing has done so much to promote free interchange among the universities of the Empire, and also with those of other countries, as the 1851 Exhibition Scholarships, and they might well form the nucleus of a great system of scholarships and fellowships expressly designed to promote that end. Since 1891 the Commissioners have appointed, on the nomination of universities throughout the Empire, in every year twenty research scholars. The number of workers thus subsidised has been small in comparison with the needs of the Empire; but it is universally admitted that the results have far more than justified the expenditure. The Consultative Committee, in its Report on Scholarships for Higher Education, notes, however, that in 1916 out of 305 scholars known to be at work, only seventy-nine were engaged in industry, as against 194 engaged in educational work and thirty-two in Government service. Moreover, of the seventy-nine engaged in industry, twelve had appointments in the United States, and seven more outside the British dominions.

The probable reason why two-thirds of these capable research students became teachers at the end of their scholarship periods is that suitable posts were not open to them in industrial works. This waste of capacity for original investigation will not be avoided unless manufacturers offer to trained researchers positions and prospects much more attractive than have been customary. Improvements have certainly been effected since the opening of the war, and the signs are favourable that the demand will increase when peace is restored. Meanwhile, the governing bodies of our universities and technical colleges should consider whether their resources will enable original investigators on their staffs to be relieved of the necessity of preparing students for examination in order to train the most gifted of them in the methods of research. Unless this relief is given, and the first duty of the occupant of a scientific chair in an institution of university rank is recognised to be the promotion of research, the award of scholarships will be in vain, and the introduction of graduates into industry will not lead to the developments necessary to make our future position high and secure among the foremost nations of the world.

BRITISH ORNITHOLOGY.

(1) *A Bibliography of British Ornithology from the Earliest Times to the End of 1912, including Biographical Accounts of the Principal Writers and Bibliographies of their Published Works.* By W. H. Mullens and H. Kirke Swann. Parts i.–vi. (London: Macmillan and Co., Ltd., 1916.) Price 6*s.* net each.

(2) *British Birds.* Written and illustrated by A. Thorburn. In 4 vols. Vol. iv. Pp. vii + 107 + plates 61–80. (London: Longmans, Green, and Co., 1916.) Price, 4 vols., 6*l.* 6*s.* net.

(1) WITH the issue of the sixth part Messrs. Mullens and Swann bring to a conclusion their great "Bibliography of British Ornithology," forming a volume of more than 700 pages. This should, perhaps, be considered as only the first section of the whole work; for hopes are held out that it is to be followed by a geographical bibliography of the same subject, which will be another very laborious and most useful undertaking.

At the foot of their prefatory note the authors disarm criticism by very fittingly quoting from Dr. Samuel Johnson's preface to his Dictionary: "In this work, when it shall be found that much is omitted, let it not be forgotten that much likewise is performed." Much, indeed, has been performed in this monumental work, and as to omissions, some sixteen pages of addenda and corrigenda go far to supply any there may have been. This later matter has been printed on one side of the paper only for the convenience of those who wish to cut it up and insert in the proper places in the work.

We have already, when noticing the earlier parts, referred to the general plan of this work, to its far-reaching scope, and to its going back to the earliest days of anything in the shape of a study of our British birds. It goes back, indeed, to Bartholomæus Anglicus, who flourished about 1230–60, and whose "De Proprietatibus Rerum," in the translation printed by Wynkyn de Worde about 1495, is one of the earliest printed works on natural history in the English language. A feature of this final part is the remarkably full and able bibliography of the "Natural History of Selborne." The many

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editions are here arranged in groups, for of some of them there have been many issues, as, for instance, that of the popular Capt. Thomas Brown, which either as a new edition or as a re-issue has appeared more than a score of times. A list of separate books and reprinted articles dealing with White and Selborne is added. This final part also contains lists of the bibliographical and biographical works which have been consulted, of the periodicals cited, and of the special abbreviations used in the present work.

The biographical side of the book can scarcely be considered so satisfactory as the bibliographical portion. To begin with, it is avowedly, and by the plan of the work unavoidably, incomplete as a biography of British ornithologists; and, indeed, it never professed to be otherwise. The aim of the authors has been "to give a biographical account of each author or co-author of a separately published work," the result being a biography of the greater part of our ornithologists—and of a good many other people, too: to wit, the authors of works which mention birds, but are of a worthless nature, ornithologically speaking at all events. At the same time we miss well-known names of really good ornithologists who have done some of the best work, and whose writings will be referred to long after more popular and showy books have sunk into oblivion, as many of them had already done. But we miss the names of these good men in the present work because their published writings appeared only in periodicals, transactions, and the like, and were not separately published. The second portion, or continuation, of the bibliography, already alluded to, will, however, doubtless set this right and complete the biography of British ornithologists. As to the biographies given of living ornithologists—a delicate subject—they vary greatly in extent; and as in this respect they probably depended a good deal on the amount of information furnished by the subjects of the respective notices, they differ greatly, as may readily be imagined, in the kind, as well as in the extent, of the information they afford. British bird-men will read them all with considerable curiosity.

(2) Mr. Thorburn and his publishers are to be congratulated on the completion, by the issue of vol. iv., of this famous and beautiful set of coloured plates of the birds on the British list. A book which stands high in the fine arts, and from its price (low as this is for all these pictures) must be looked upon as one of the luxuries of life, has been begun and finished during the Great War. The volume now before us includes the wading birds (plovers, sandpipers, etc.), the terns, gulls, skuas, auks, divers, grebes, and petrels. They are beautifully drawn and coloured and true to Nature, though in one or two cases it may seem to some people that the peculiar attitudes are a little exaggerated. The colour reproduction leaves little or no fault to be found. But the former remark does not apply to the valuable and most interesting drawing of a "drumming" snipe, which, "made from sketches taken in the spring of 1914 after watching the bird, shows the position of the outer tail-feathers, spread out and separated only during the descent." The letterpress notes are concise, but most useful, informing, and very much to the point. To those who wish to have a good coloured figure of every species of bird which has ever occurred in a wild state in this country, it may be said that this is the only work which can satisfy them. A more desirable book for the country-house library or billiard-room it would be difficult to find.

THE NUTRITION OF FARM ANIMALS.

The Nutrition of Farm Animals. By Dr. H. P. Armsby. Pp. xvii+743. (New York: The Macmillan Co.; London: Macmillan and Co., Ltd., 1917.) Price 11*s*. net.

GREAT advances have been made in the study of animal nutrition since Dr. Armsby first began his investigations at the State College of Pennsylvania and wrote his "Manual of Cattle Feeding" and his "Principles of Animal Nutrition." He has now brought together the material and presented it anew. There has been no fundamental upheaval since the last edition of his earlier book appeared, but there have been remarkable changes in details, and in consequence the picture is now very different from what it was, though it is still recognisable in its main features.

In the first section, dealing with the composition of plants and of the animal body, considerable advances are recorded in our knowledge of the lipoids, the proteins, and the non-protein nitrogenous substances.

The second section deals with digestion and resorption, and gives a useful summary of the American and German investigations. Considerable interest attaches to the digestion of carbohydrates. For long it was supposed that the cellulose of feeding-stuffs was indigestible: no digestive enzyme was known to attack it, and there seemed no mechanism for breaking it down. Henneberg and Stohmann proved that it was digested, and at a later date both Wildt and Zuntz showed that the process occurs in the portions of the alimentary canal where the food stagnates, *i.e.* in the paunch of ruminants, and in the cæcum and colon. Later investigations indicate that it is brought about by organisms inhabiting the alimentary canal, and that it gives rise to considerable quantities of carbon dioxide and methane, as well as various acids, mainly acetic and butyric. These are resorbed as salts, which appear to constitute the sole contribution that cellulose makes to the nutrition of the animal body. One cannot help wondering whether better use could not be made of the cellulose by subjecting it to some chemical or bacterial treatment before using it. Apparently the pentosans are digested in the same way, and also the mucilage of linseed cake, according to Neville's experiments, which, however, the author does not mention. Bacteria cause

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